principia SPACE DIARY

## ACTIVITY 4.1
## SPACE GARDENING

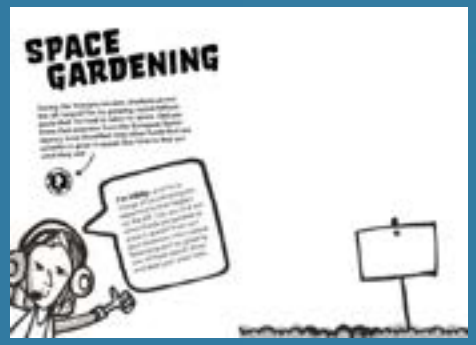
*From Chapter 4 of the Principia Space Diary*
*http://principiaspacediary.org/activities/space-gardening*

## LEARNING LEVEL

*KS1, KS2, P1-5*

## CURRICULUM LINKS & DIFFERENTIATION IDEAS

View detailed curriculum links for England, Scotland, Northern Ireland and Wales, plus differentiation ideas for your region and year level.
**principiaspacediary.org/curriculum-planner/**




### Resources Required

- Coloured pens and pencils
- Access to internet
- Some of the space foods: soybean, tomato, wheat and rice (optional)

### Background to this Activity

Growing plants on the ISS is an important research area as it has the potential to help future exploration. Growing edible plants in space would add variety to the food on board for astronauts, and would also reduce the amount of provisions needed for long duration fights. The emotional benefit of having and caring for plants is also a factor that could help astronauts who are in space for long periods of time.

The International Space Station is not your typical garden. The ISS garden does not have the things a garden usually needs: soil, oxygen and direct sunlight. So astronauts are finding new ways to grow plants. On Earth, stems and leaves grow towards the light (called phototropism), while roots follow gravity, heading towards Earth's centre (called gravitropism). This is why scientists are particularly interested in what happens to plants in space, where there is no gravity and no direct sunlight.

### Running the Activity

In this activity, students will consider the different elements that impact the growth of plants. Lead a class discussion about the benefits of bringing seeds into space instead of the grown plant.

A team of European Space Agency (ESA) scientists has created a list of the top 10 plants to grow in space: soybean, potato, wheat, tomato, spinach, lettuce, beetroot, onion, rice and spirulina. You can find out more about why these plants are useful for astronauts at http://principiaspacediary.org/veg-in-space/.

In groups, students can rank these plants based on:

- Best for growing in space
- Tastiest
- Most nutritious

Students can then choose their own favourite plant in the box and label the features of it.

### Questions for the Class

- Why do we want to grow plants in space?
- Can you design a greenhouse (or biodome) that could grow plants in space?
- Which plant would you choose to grow and why?
- Why might you want to send seeds into space, rather than actual plants?

### Extensions & Digital Resources

**ZAP!** Students can use the Zappar app to see photographs of the food that can be grown in space. These foods are shown while growing and also after being harvested so children can see them in different states. See Zappar instructions at the link below and note that the mobile/tablet will need to be connected to the internet: http://principiaspacediary.org/using-zap-codes-to-strengthen-digital-literacy/

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## ACTIVITY 4.2
## MAKE A SPLASH IN SPACE

*From Chapter 4 of the Principia Space Diary*
*http://principiaspacediary.org/activities/make-a-splash-in-space*

## LEARNING LEVEL

*KS1, KS2, P1-5*

## CURRICULUM LINKS & DIFFERENTIATION IDEAS

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**principiaspacediary.org/curriculum-planner/**


### Resources Required

- Cardboard and markers for making lifecycle cards

### Background to this Activity

Just like on Earth, water on board the ISS is key to survival. However, it is also scarce. Water is very heavy and therefore expensive to send into space. Astronauts need water for the same reasons we need water here on Earth: to drink, wash, clean their teeth and to rehydrate the food they eat. There are no running taps on the ISS – instead, water is carefully recycled.

In this exercise, students will consider what happens to the water that astronauts drink and how the water from urine, breath, condensation and sweat is recycled. Even the breath from animals on the ISS is recycled!

### Running the Activity

A great starting point is this video of Tim Peake demonstrating what happens to water at zero gravity. Note that this is not a bubble Tim makes, it's a sphere of water: http://www.bbc.co.uk/newsround/35299919

Encourage students to think about all the possible uses for water on the ISS and how one might be recycled into another. You can ask your students to think about what happens to their own urine (a conversation that will no doubt get their attention!) and what happens at water treatment plants.

A straightforward diagram of how water is treated is available online, for example: https://www.thameswater.co.uk/help-and-advice/water-quality/how-we-look-after-your-water/drinking-water-treatment

Consider how there is a finite amount of water available on the ISS – make links between how this is also true on Earth and so we recycle our water: cleaning it between uses. Lead a class discussion about the uses of water on the ISS. Can children come up with ideas about how one use could be recycled into another? Obviously there is not a large water treatment plant on the ISS but water undergoes a similar process.

Encourage the children to think about what happens to a droplet of water on the ISS. This could be done in groups with children taking on the role of the water droplet and explaining what is happening to them at each stage of their journey.

Children should then complete the life cycle diagram, explaining the stages:

i. Astronaut drinks water.
ii. Water vapour (from astronauts' breath) and waste water (from urine and washing) is collected by the Water Recovery System.
iii. Water is purified by the purification system
iv. Astronauts can then drink water from the purification machine at its Rehydration Station.

### Questions for the Class

- What are some of the ways that we recycle things here on Earth, and why do we recycle?
- What other things are recycled on the ISS? Hint – astronauts need to breathe both inside the ISS and while on spacewalks.
- Where does drinking water on Earth come from? How is this different to the water Tim Peake drinks?
- On the ISS, water is very precious and mustn't be wasted. What are some of the methods we use on Earth to reduce our water waste?

### Extensions & Digital Resources

**ZAP!** Use the Zappar app to see how Tim washed, went to the toilet and made coffee on the ISS!. See Zappar instructions at the link below and note that the mobile/tablet will need to be connected to the internet: http://principiaspacediary.org/using-zap-codes-to-strengthen-digital-literacy/

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## ACTIVITY 4.3
## EXPERIMENTALLY YOURS

*From Chapter 4 of the Principia Space Diary*
*http://principiaspacediary.org/activities/experimentally-yours*

## LEARNING LEVEL

*KS1, KS2, P1-5*

## CURRICULUM LINKS & DIFFERENTIATION IDEAS

View detailed curriculum links for England, Scotland, Northern Ireland and Wales, plus differentiation ideas for your region and year level.
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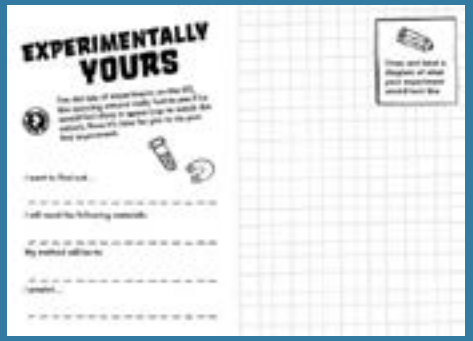


### Resources Required

- Paper and markers for brainstorming (optional)

### Background to this Activity

At any given time on the ISS, more than 150 experiments involving researchers from around the world are active. Tim's experiments included some that have been suggested by UK school children through the AstroPi programme, through the cosmic rays experiment and the Rocket Science experiment that saw thousands of schoolchildren help Tim to grow space lettuce. Tim's body is an experiment too! When he returned from space, doctors took blood and other medical samples from him for analysis.

### Running the Activity

This activity would work well alongside a series of lessons covering the investigative process.

Begin by leading a class discussion on the different things they would like to investigate. Guide the children to think about questions they could investigate in space – perhaps they could consider how the results could vary depending on where the experiment takes place.

Gather lots of ideas, such as these experiments that have already taken place on the ISS:

- Can a spider spin a web in space?
- Does the smell of a rose change in space?
- What happens to a rat during a long duration mission in space?
- What happens to fire in space?
- How can we make a cup of coffee in space?

In groups, children should discuss some of the ideas gathered, thinking about what equipment might be needed to carry it out and what they would expect he results to be. Again, some children may be able to explain how they expect the results to vary between the ISS and Earth.

Guide the children through the steps of an experiment so that they get a sense of how an investigation is planned – the amount of guidance necessary will depend on the age of the children.

This website has some good tips: http://www.sciencekidsathome.com/science_fair/index.html

### Questions for the Class

- What are some of the factors that limit what experiments can be done in space (cost, ethics, size of equipment, risk factors for the crew members, training, sample return, difficulties of analysing results)?
- Why would we want to conduct science experiments?
- What are the main steps of conducting an experiment?
- What are some of the scientific tools you have at school? What kinds of tools do you think Tim Peake might use on the ISS?
- Why might it be important to conduct the same experiment a few different times?
- Design an experiment you can do at school at least three times, and see if the results are consistent.

### Extensions & Digital Resources

To help with this activity we have prepared some extra materials that you can download from http://principiaspacediary.org/activities/experimentally-yours. These have been developed by teacher Claire Loizos.

**ZAP!** Students can use the Zappar app to watch a video of Tim Peake doing an experiment to test how dizzy he would get in space. See Zappar instructions at the link below and note that the mobile/tablet will need to be connected to the internet: http://principiaspacediary.org/using-zap-codes-to-strengthen-digital-literacy/